BLM LIBRARY
88069414

File

ANNUAL REPORT

1962

COOPERATIVE RESEARCH PROJECT
Supplement No. 3)

"The Chemical and Physical Responses of Desert Shrubs and Grasses To Defoliation"

Utah Agricultural Experiment Station
and
Bureau of Land Management
Department of the Interior

FOR OFFICIAL USE ONLY

NOT FOR PUBLICATION

QK
938
.D4
C66
1962

ISO LIBRARY
10/22/04

Utah State Office
February 1963

61220

#909294731 ID88069414
QK 938 .D4 C66 1962

ANNUAL PROJECT REPORT AND WORK PLAN

Agricultural Experiment Station
Utah State University
Logan, Utah

Project No. 581

Year 1962

Fund State Match Grant BLM

1. Title of project: The chemical and physical responses of desert shrubs and grasses to defoliation

2. Leaders: C. Wayne Cook
L. A. Stoddart

3. Cooperation
Utah State Agricultural Experiment Station; Department of Range Management, Utah State University; Bureau of Land Management, U. S. Department of Interior.

4. Date initiated or last revised
July 1, 1961

6. Major objectives of project:

1. To determine the chemical and physiological responses of desert browse and grass to forage removal at 3 different intensities and during 4 different periods during winter, spring and summer.

2. To determine the recovery of desert browse and grass after being subjected to 3 years of treatment involving 3 intensities of forage removal during 4 different periods during the winter and spring in a previous study.

BUREAU OF LAND MANAGEMENT LIBRARY
BLDG. 50,
DENVER FEDERAL CENTER
P.O. BOX 25047
DENVER, COLORADO 80225

Prepared by

C. Wayne Cook
Project leader in charge

Approved by

Head of department

Director

RECEIVED
UTAH AGR. EXPT. STATION
JAN 31 1963

7. Major accomplishments prior to 1962:

In 1955, individual plants of seven important salt desert shrubs and grasses were permanently marked at two locations. Sixteen hundred and eighty individual plants or plots of seven major salt-desert range species were clipped for 3 years (1956-58) to determine yield under three intensities of harvesting during four seasons. Vigor of these plants also was measured, including length of seedstalk, length of vegetation twigs, number of seedstalks, and extent of dying. The four dates of harvesting were: late fall (November 1); early winter (January 1); late winter (March 1); and spring (May 1). The three intensities of harvesting were: light (25%), moderate (50%), and heavy (75%).

Heavy utilization materially reduced production of most species. In many cases 75 percent removal during the 1957-58 season gave no more herbage than was secured from the 25 percent removal group. For example, white sage in the first year yielded 18, 29, and 49 grams per plot when harvested at 25, 50, and 75 percent intensity. The same plants the third year of clipping yielded about 15 grams per plot under each intensity. Clipping in the spring, when plants were actively growing, gave higher yields the first year. By the third year, however, spring-clipped plants generally yielded no more, and in some cases substantially less, forage than plants harvested during the dormant season. Yields did not vary noticeably among the plants clipped at the three earlier dates (fall, early winter, and late winter).

By 1958, close grazing no longer yielded greater amounts of herbage than lighter intensities of grazing. Interaction was apparently showing that close grazing to be comparatively much more harmful in spring than in winter.

Vigor measurements also showed that heavy clipping in the spring was most harmful of all treatments. Without exception, spring clipping reduced twig length and seedstalk production and caused dying of parts or all of some plants. Black sagebrush, for example, produced only about one-twentieth as many seedstalks after three years of spring utilization, compared to unclipped plants. This seems to point conclusively to danger of grazing winter ranges too late in spring. Grazing these species at any season appeared to reduce seedstalk production, but reduction was much greater under 75 percent utilization. Black sagebrush, for example, produced only about one-tenth as many seedstalks after three years of 75 percent utilization compared to unclipped plants. Big sagebrush plants were 96 percent dead after three years of this heavy utilization. Obviously, heavy grazing, especially in the spring, is serious on salt desert ranges.

Chemical analysis in most cases showed that protein, cellulose, and gross energy decreased with increased intensity of harvesting; whereas, lignin increased.

The effect of season on the nutrient content was more pronounced than intensity of harvesting. Ether extract, ash, lignin, and cellulose decreased during late winter and early spring, but protein, gross energy, available carbohydrates, and phosphorus increased.

Nutrient value was greatest during the spring season, but all harvesting intensities were detrimental to yield and vigor during this period.

7. Continued.

A revision of this study was initiated in 1959. Three representative study areas were selected in the salt-desert area of western and northern Utah. In each of these three areas, 5 to 7 study plots of about 3-acre size were located and fenced to exclude livestock. In addition, where necessary, these plots were fenced to exclude jackrabbits.

Within each of these study plots, 130 individual plants for each species were selected and marked with iron pins for defoliation response studies. Seven major species were selected for study, including black sagebrush, big sagebrush, shadscale, white sage, Nuttall saltbush, Indian ricegrass, and squirreltail grass. The clipping treatments involved four seasons and three intensities in all combinations. Seasons were: (1) winter alone (January 1); (2) winter and late spring (January 1 and May 1), (3) early spring alone (April 1), and (4) late spring alone (May 1). Intensities included 30, 60, and 90 percent removal of current growth. Ten samples were taken from each species for each treatment at each area. For each treatment, data were taken to show weight of herbage produced and vigor of growth, number of seedstalks, and various appraisals of survival or dead versus living cover.

The new design which was initiated during the winter and spring of 1959 differed from that followed during the first three years in that one additional replication was added. The intensities of harvesting were increased slightly and more spring treatments were introduced.

8. Major accomplishments in 1962:

Data collected over the three years 1959-61 were summerized and analyzed statistically. Mean values for production and percent crown dead for the three years and percent plants dead at the end of three years of treatment are presented in Tables 1 to 7. Statistical analyses for these data are found in Tables 8 to 10. A brief summary of data for all seven plant species for all treatments for percent dead material and number of dead plants after three years of treatment are presented in Table 11. Average production during 4 periods at three intensities for all species in 1959 and in 1961 along with percent reduction in forage yield from 1959-61 is also shown in Table 11. The over-all effect of defoliation on each of the seven species for three years (1959-61) is presented in Table 12.

Vigor measurements made the year following cessation of treatment (August, 1962) are shown in Tables 13-19.

The vigor measurements, in all cases, show that harvesting in the winter (January 1) and again in the spring (May 1) was the most detrimental to plant welfare. Late spring (May 1) was more adverse to plant sustenance than early spring (April 1), and harvesting in the winter only was the least detrimental of all seasons tested. As intensity of harvesting increased, vigor of plants was lowered. This was true for all periods of harvesting (Tables 13-19).

Production per plant from 1959 to 1961 was reduced for all periods of harvesting and for all intensities of harvesting (Table 11). Reduction in yield was greatest for plants harvested once in the winter and again in the spring and least for plants harvested in winter only and early spring only. Again it should be pointed out that harvesting in late spring reduced the yield markedly more than plants harvested in the early spring. This reduction in yield for the various periods of harvesting is reflected in the percent of the crown of the plant that appeared dead and percent of the plants dead at the end of the three years of treatment (Table 11).

Percent reduction in forage yield, percent dead crown material and dead plants all increased with increased harvesting intensity (Table 11).

It appeared that Nutall's saltbush, winterfat, and Indian ricegrass withstood defoliation over the three years (1959-61) better than the other four species and big sagebrush, squirreltail grass and shadscale were the most susceptable to harm from defoliation (Table 12).

Data collected in August, 1962 on vigor measurements for the seven species treated for three years (1959-61) are presented in Tables 13-19. Statistical analysis for these data for each species are presented in Tables 20-23.

All vigor measurements made the year following the cessation of treatment showed that plants were significantly affected by both season and intensity of grazing. Length of current year's growth, length of seed stalks, and number of seed stalks were less for each increased intensity of clipping for all species (Tables 13-19). Percent of crown dead and percent of plants dead increased with each increased intensity of grazing (Tables 13-19). Plants clipped in the winter (January 1) were least harmed and plants clipped in the winter and again in the spring (January 1 and May 1) were most harmed. Late spring clipping (May 1) was considerably more detrimental to plant welfare than early spring clipping (April 1).

Precipitation during 1962 at each location is shown in Tables 24-26.

9. Value of results to farm people or other citizens of Utah, the region, or the nation:

Semi-desert ranges of the Intermountain-Great Basin region occupy more than 50 percent of the total land area and furnish winter and early spring grazing for most of the livestock produced in this region and year-long grazing for some.

Since desert ranges are so vital to the western livestock industry, it is important to determine the grazing tolerance of the major species during various seasons. Only when such fundamental knowledge is known can we intelligently manage these ranges for sustained yield of forage and nutrients.

10. Publications during the year (give complete citation):

None.

11. Manuscripts in preparation:

"Period of use is important in managing desert ranges."

12. Objectives of work in 1963 :

1. To determine the chemical and physiological responses of desert browse and grass to forage removal at 3 different intensities during 4 different periods including winter, spring and summer.

13. Plan of work for 1963:

Three representative study areas have been selected in the semi-desert region of western and northern Utah. In each of these, 7 exclosures or study plots of about 3-acre size have been located and fenced to exclude livestock. In addition, many of these plots have been fenced to exclude jackrabbits where necessary. One major species of prominance was included in each exclosure.

Within these three exclosures, a total of 2520 individual plants have been selected and marked with iron pins for clipping response studies. Seven major species were selected for study, including black sage, big sagebrush, shadscale, winterfat, Nuttall saltbush, Indian ricegrass, and squirreltail. For each species, 360 individuals were chosen and will be subjected to twelve different clipping treatments for a second year to determine how they react to herbage removal. These clipping treatments involve four seasonal periods and three intensities in all combinations. Seasons will be (1) winter alone (January 1), (2) spring alone (April 15), (3) spring every second year (April 15) starting 1962, and (4) summer (July 15). Intensities include 25, 50, and 75 percent removal of current growth. Ten samples of each species will be taken for each treatment in each area. On each treatment, each year, data will be taken to show weight of herbage produced and vigor of growth. Vigor will be measured at the end of the growing season and will include length of current growth, number of seedstalks, and various appraisals of degree of survival. Vigor on the summer treatment will be measured prior to harvesting each year after treatment is initiated.

The harvested herbage for each treatment will be ground and analyzed chemically to determine the nutrient content for the first year of treatment 1961 and at 3-year intervals thereafter.

Table 1. Average production, percent of crown growth and percent of plants dead as a result of three years of artificial grazing (1959-61) during four seasons at three intensities for black sage.

Treatment		Production 1/			Percent crown growth dead			% Plants Dead
		1959	1960	1961	1959	1960	1961	1961
Winter	30	11.70	6.11	4.37	17.03	20.85	22.50	3.33
	60	18.50	7.96	4.54	27.00	31.36	34.43	6.67
	90	24.30	6.76	4.32	53.42	63.89	75.00	16.67
	Avg.	18.16	6.95	4.41	32.49	38.78	43.97	8.89
Winter and Spring	30	22.50	11.13	4.06	26.31	39.18	45.12	6.67
	60	23.94	9.15	2.61	44.20	61.66	77.28	20.00
	90	31.28	6.43	0.45	69.35	95.80	97.44	80.00
	Avg.	25.90	8.90	2.37	46.62	65.55	73.28	35.56
Early Spring	30	10.61	3.06	4.15	17.94	24.61	21.70	6.67
	60	15.73	4.76	4.46	26.14	33.09	32.39	3.33
	90	22.36	3.96	2.10	48.38	61.59	83.02	33.33
	Avg.	16.23	3.93	3.57	30.82	39.77	45.71	14.44
Late Spring	30	12.58	12.41	4.39	16.63	28.35	23.57	10.00
	60	22.26	14.36	5.20	29.48	45.76	41.82	10.00
	90	27.45	10.53	1.10	62.86	79.82	84.77	43.33
	Avg.	20.76	12.43	3.56	36.33	51.31	50.05	21.11
Control		———	———	———	11.66	17.55	17.81	0.00
Average Intensity	30	14.35	8.18	4.24	19.48	28.25	28.22	6.67
	60	20.11	9.06	4.20	31.71	43.03	46.48	10.00
	90	26.35	6.92	1.99	58.50	75.28	85.06	43.33

1/Grams of herbage harvested per plant.

Table 2. Average production, percent of crown growth and percent of plants dead as a result of three years of artificial grazing (1959-61) during four seasons at three intensities for big sagebrush.

Treatment		Production 1/			Percent crown growth dead			% plants dead
		1959	1960	1961	1959	1960	1961	1961
Winter	30	28.25	16.26	12.57	16.43	23.61	23.85	6.67
	60	38.01	16.30	9.88	29.93	38.87	40.23	10.00
	90	54.18	10.13	5.31	71.17	76.85	83.16	63.33
	Avg.	40.15	14.23	9.25	39.17	46.44	49.08	26.67
Winter and Spring	30	34.25	23.90	12.70	28.31	45.15	41.53	6.67
	60	46.25	22.96	8.15	36.38	54.73	73.80	23.33
	90	69.53	8.36	0.11	86.89	99.28	100.00	100.00
	Avg.	50.01	18.41	6.98	50.53	66.38	71.77	43.33
Early spring	30	23.25	14.31	14.58	17.86	20.56	18.88	0.00
	60	26.15	17.25	13.38	20.80	26.05	29.09	6.67
	90	48.90	14.10	8.43	40.88	64.93	74.37	36.67
	Avg.	32.76	15.22	12.13	26.51	37.18	40.78	14.45
Late spring	30	23.41	25.43	13.81	16.83	26.16	21.41	0.00
	60	40.85	29.65	16.65	28.17	36.13	39.36	10.00
	90	51.90	20.13	2.83	55.40	85.64	94.82	80.00
	Avg.	38.72	25.07	11.10	33.47	49.31	51.86	30.00
Control		———	———	———	10.88	22.93	21.49	3.33
Average intensity	30	27.29	19.97	13.41	19.86	28.87	26.42	3.34
	60	37.81	21.54	12.01	28.82	38.95	45.62	12.50
	90	56.12	13.18	4.17	63.58	81.67	88.09	70.00

1/Grams of herbage harvested per plant.

Table 3. Average production, percent crown grown and plants dead as a result of three years of artificial grazing (1959-61) during four seasons at three intensities for shadscale.

Treatment		Production 1/			Percent crown growth dead			% plants dead
		1959	1960	1961	1959	1960	1961	1961
Winter	30	15.01	10.71	5.03	26.65	30.64	42.12	3.34
	60	22.25	11.70	6.56	29.48	30.80	45.44	6.67
	90	32.46	11.90	7.11	39.10	51.87	78.19	26.67
	Avg.	23.24	11.43	6.23	31.41	37.77	55.25	12.23
Winter and Spring	30	20.98	17.58	7.62	30.91	40.59	50.57	10.00
	60	34.35	20.06	7.06	35.05	51.61	76.13	26.67
	90	44.78	10.71	0.88	58.68	85.35	97.28	80.00
	Avg.	33.37	16.12	5.19	41.55	59.18	74.66	38.89
Early spring	30	11.18	6.61	5.26	27.87	28.98	36.03	3.33
	60	17.40	9.33	6.20	33.87	37.76	51.37	6.67
	90	29.33	11.40	5.70	37.27	50.39	74.19	23.33
	Avg.	19.30	9.11	5.72	33.00	39.04	53.86	11.11
Late spring	30	11.85	9.21	5.26	33.85	41.37	49.33	6.67
	60	17.56	15.13	6.48	35.62	46.59	56.30	13.38
	90	32.93	15.45	2.95	49.19	61.09	79.65	33.33
	Avg.	20.78	13.26	4.90	38.22	49.68	61.76	17.78
Control		———	———	———	20.21	25.29	28.86	0.00
Average intensity	30	14.75	11.03	5.79	29.57	35.40	44.51	5.84
	60	22.84	14.05	6.57	33.51	41.69	57.31	13.34
	90	34.88	12.36	4.16	45.06	62.17	82.33	40.83

1/Grams of herbage harvested per plant.

Table 4. Average production, percent crown growth and plants dead as a result of three years of artificial grazing (1959-61) during four seasons at three intensities for white sage.

Treatment		Production 1/ 1959	1960	1961	Percent crown growth dead 1961	% plants dead 1961
Winter	30	22.86	15.25	12.40	27.41	0.00
	60	39.13	20.48	18.08	30.28	5.82
	90	59.28	20.50	19.11	50.70	6.76
	Avg.	40.42	18.74	16.53	35.96	4.19
Winter and Spring	30	38.16	28.43	16.28	42.62	0.00
	60	55.00	29.93	15.53	59.54	6.30
	90	73.06	29.88	8.06	90.20	43.69
	Avg.	55.41	29.41	13.29	64.12	16.66
ly spring	30	22.36	15.00	12.00	29.87	0.00
	60	30.50	20.66	12.11	40.58	8.65
	90	50.03	24.23	13.26	55.00	7.08
	Avg.	34.30	19.96	12.46	41.81	5.24
Late spring	30	23.73	26.31	14.95	37.00	0.00
	60	33.40	28.96	23.85	48.45	6.12
	90	60.03	32.48	9.06	84.33	26.84
	Avg.	39.05	29.25	15.95	56.59	10.99
Control		———	———	———	20.00	0.00
Average intensity	30	26.78	21.25	13.91	34.22	0.00
	60	39.50	25.01	17.39	44.71	6.72
	90	60.60	26.77	12.37	69.93	21.09

1/Grams per 9.6 square-foot plot.

Table 5. Average production, percent crown growth and plants dead as a result of three years of artificial grazing (1959-61) during four seasons at three intensities for Nuttall saltbush.

Treatment		Production 1/ 1959	1960	1961	Percent crown growth dead 1961	% plants dead 1961
Winter	30	11.31	15.81	15.53	21.70	0.00
	60	20.73	30.16	30.56	26.75	2.02
	90	29.91	39.23	32.81	37.95	1.59
	Avg.	20.65	28.40	26.30	28.80	1.20
Winter and Spring	30	18.45	16.45	23.63	26.33	0.26
	60	29.33	21.43	26.18	42.25	8.00
	90	39.66	29.91	19.25	65.62	23.72
	Avg.	29.15	22.60	23.02	44.73	10.66
ly spring	30	8.85	14.05	12.08	20.83	4.09
	60	12.86	24.06	19.30	23.89	5.01
	90	21.65	35.80	26.88	36.45	4.92
	Avg.	14.45	24.63	19.42	27.06	4.67
Late spring	30	13.08	28.88	17.75	22.50	1.52
	60	16.40	30.91	16.56	31.58	9.09
	90	27.66	49.10	20.01	49.22	14.94
	Avg.	19.05	36.30	18.11	34.43	8.52
Control		———	———	———	18.04	0.00
Average intensity	30	12.92	18.80	17.25	22.84	1.47
	60	19.83	26.64	23.15	31.11	6.03
	90	29.72	38.51	24.74	47.31	11.29

1/Grams per 9.6 square-foot plot.

Table 6. Average production, percent crown growth and plants dead as a result of three years of artificial grazing (1959-61) during four seasons at three intensities for Indian ricegrass.

Treatment		Production 1/			Percent crown growth dead			% plants dead
		1959	1960	1961	1959	1960	1961	1961
Winter	30	4.51	3.25	1.87	15.00	50.00	37.50	0.00
	60	8.11	3.03	2.46	12.50	47.50	45.00	3.33
	90	16.53	3.35	4.13	32.50	57.50	62.50	15.62
	Avg.	9.72	3.21	2.82	20.00	52.50	47.50	6.32
Winter and Spring	30	5.90	7.21	1.74	17.50	55.00	57.50	3.33
	60	9.30	7.48	1.95	12.50	62.50	65.00	20.00
	90	17.23	6.86	1.70	27.50	75.00	80.00	30.00
	Avg.	10.81	7.18	1.80	20.00	62.50	67.50	17.78
E[illegible] spring	30	6.80	0.83	2.11	2.50	47.50	37.50	0.00
	60	10.23	1.13	2.71	17.50	55.00	55.00	3.33
	90	14.96	1.26	2.67	30.00	62.50	67.50	16.67
	Avg.	10.66	1.07	2.49	17.50	55.00	52.50	6.67
Late spring	30	4.78	6.50	2.02	7.50	50.00	35.00	3.33
	60	7.68	6.56	1.85	22.50	57.50	57.50	10.00
	90	11.36	5.55	0.96	32.50	75.00	80.00	16.67
	Avg.	7.94	6.20	1.61	20.00	60.00	57.50	10.00
Control		———	———	———	10.00	27.50	27.50	3.33
Average intensity	30	5.50	4.45	1.94	10.00	50.00	42.50	1.67
	60	8.83	4.55	2.24	17.50	55.00	55.00	9.16
	90	15.02	4.25	2.36	30.00	67.50	72.50	19.74

1/ Grams of herbage harvested per plant.

Table 7. Average production, percent crown growth and plants dead as a result of three years of artificial grazing (1959-61) during four seasons at three intensities for squirreltail grass.

Treatment		Production 1/			Percent crown growth dead			% Plants Dead
		1959	1960	1961	1959	1960	1961	1961
Winter	30	2.35	1.41	1.10	0.00	30.00	42.50	3.33
	60	3.68	1.98	1.91	0.00	12.50	35.00	3.33
	90	6.31	1.50	1.34	12.50	25.00	45.00	10.00
	Avg.	4.11	1.63	1.45	5.00	22.50	40.00	5.55
Winter and Spring	30	4.46	5.35	0.90	5.00	40.00	55.00	20.00
	60	4.73	4.66	0.71	12.50	57.50	70.00	36.67
	90	8.83	4.13	0.82	35.00	80.00	85.00	63.33
	Avg.	6.01	4.71	0.81	17.50	60.00	70.00	40.00
Early spring	30	3.86	1.31	1.57	0.00	27.50	35.00	3.33
	60	4.23	1.56	1.24	2.50	27.50	60.00	6.67
	90	6.73	2.00	1.48	10.00	42.50	72.50	10.00
	Avg.	4.94	1.62	1.43	5.00	32.50	55.00	6.67
Late spring	30	4.28	5.20	1.17	0.00	35.00	45.00	6.67
	60	5.76	4.38	0.91	0.00	52.50	65.00	30.00
	90	6.75	4.73	0.60	17.50	62.50	80.00	50.00
	Avg.	5.60	4.77	0.89	5.00	50.00	62.50	28.89
Control		———	———	———	0.00	22.50	32.50	0.00
Average intensity	30	3.74	3.32	1.18	0.00	32.50	45.00	8.33
	60	4.60	3.15	1.19	2.50	37.50	57.50	19.16
	90	7.15	3.09	1.06	20.00	52.50	70.00	33.33

1/Grams of herbage harvested per plant.

Table 8. Analysis of variance for production, number of plants per plot and vigor measurements for desert plants clipped during four seasons at three intensities for three years 1959-61.

Source	D.F.	Mean Squares: Length of seedstalk	Length of current growth	Number of seedstalks	Percent dead	Production
Black sage						
Area	2	105.30	0.43	17,269.93	16,812.08	3,467.28
Season (S)	3	192.56**	7.69**	17,898.30**	32,391.04**	1,237.72**
Intensity (I)	2	294.48**	7.94**	11,901.29**	213,299.40**	794.76**
S x I	11	10.06	0.72	663.23	727.83	71.51
Error (a)	35	7.31	0.36	1,823.21	711.85	74.48
Years (Y)	2	574.81**	49.82**	30,126.91**	26,934.14**	27,111.42**
Y x S	11	21.97**	1.42**	4,660.70**	771.84**	423.05**
Y x I	8	13.64**	2.32**	1,952.93*	1,235.40**	966.27**
Y x S x I	35	2.24	0.22	201.79	204.67**	9.77
Error (b)	107	4.42	0.53	761.52	104.87	84.26
Big sage						
Area	2	43.82	128.12	738.50	36,113.55	15,961.12
Season(S)	3	98.22**	27.75**	20,266.29**	36,878.93**	1,824.66**
Intensity (I)	2	886.58**	122.09**	69,585.51**	272,524.65**	1,882.91**
S x I	11	5.71	4.65	2,227.66**	802.12	214.90
Error (a)	35	6.37	2.67	347.79	1,035.53	298.82
Years (Y)	2	1,021.39**	145.93**	31,115.85**	25,267.82**	89,682.22**
Y x S	11	7.33	2.71	2,426.21**	359.51**	1,476.39**
Y x I	8	9.96*	8.85**	3,046.59**	1,324.90**	7,254.77**
Y x S x I	35	2.70	3.61**	351.19**	482.13**	100.98
Error (b)	107	4.86	1.53	119.47	125.23	292.58
Shadscale						
Area			942.81		39,764.54	9,021.50
Season (S)			419.80		17,276.45**	2,329.38**
Intensity (I)			242.48		67,987.94**	3,983.58**
S x I			259.43		1,125.01	115.76
Error (a)			328.98		573.78	130.45
Years (Y)			1,858.70**		58,409.82**	32,016.53**
Y x S			382.67		517.74*	575.80**
Y x I			403.32		1,926.24**	2,192.41**
Y x S x I			211.85		139.57	64.16
Error (b)			275.68		254.16	143.48

Table 9 . Analysis of variance for production, number of plants per plot and vigor measurements for desert plants clipped during four seasons at three intensities for three years 1959-61.

Source	D.F.	Mean Squares: Length of seedstalk	Length of current growth	Number of seedstalks	Production	Number of plants per plot
White sage						
Area	2	849.47	148.60	535.09	9,356.08	27,942.53
Season (S)	3	277.65**	46.74**	225.83**	5,353.30**	242.20
Intensity (I)	2	164.36**	52.28**	422.65**	14,316.18**	2,816.93**
S x I	11	2.17	1.60	5.12	125.69	70.14
Error (a)	35	16.82	1.89	25.38	187.62	123.24
Years (Y)	2	249.98**	43.31**	32.02*	71,241.94**	138.63*
Y x S	11	18.45	2.22	19.89**	1,503.09**	51.75
Y x I	8	0.94	3.28	18.95**	5,613.54**	154.50**
Y x S x I	35	1.57	0.94	4.67	128.93	45.63
Error (b)	107	13.06	5.55	6.97	126.62	44.93
Nuttall saltbush						
Area	2	1,508.73	493.03	5,022.88	15,618.46	220,216.21
Season (S)	3	250.87**	18.30**	6,103.59**	1,943.20*	138.68
Intensity (I)	2	96.92**	2.38	1,751.23**	19,389.24**	378.84
S x I	11	15.70	1.97	72.78	411.51	50.59
Error (a)	35	12.16	3.07	226.06	446.77	545.47
Years (Y)	2	2,204.35**	184.70**	7,025.34**	5,480.81**	488.38**
Y x S	11	43.61*	5.28*	1,173.14**	1,626.75*	74.53**
Y x I	8	32.97	1.66	237.46**	714.20	84.92**
Y x S x I	35	7.83	1.74	40.64	119.96	16.52
Error (b)	107	18.91	2.46	84.43	843.28	25.14

Table 10. Analysis of variance for production, number of plants per plot and vigor measurements for desert plants clipped during four seasons at three intensities for three years 1959-61.

Source	D.F.	Mean Squares: Length of seedstalk	Number of seedstalks	Production	Basal density rating
Indian ricegrass					
Area	2	13,852.97	4,755.52	1,456.67	51.10
Season (S)	3	916.93**	563.81**	170.33**	9.31**
Intensity (I)	2	1,417.81**	407.59**	970.21**	74.95**
S x I	11	100.88	43.64	27.58	1.38
Error (a)	35	77.11	70.50	30.33	1.50
Years (Y)	2	954.26**	1,416.54**	5,494.49**	277.22**
Y x S	11	70.93	165.83	196.45**	1.40
Y x I	8	18.58	14.27	460.35**	1.10
Y x S x I	35	29.06	15.62	5.29	1.58
Error (b)	107	84.23	98.99	10.67	1.63
Squirreltail					
Area	2	658.83	7,034.23	910.18	32.16
Season (S)	3	997.58**	2,293.39**	147.89**	55.11**
Intensity (I)	2	733.88**	1,486.82**	103.15**	70.18**
S x I	11	26.84	62.73	4.59	3.71*
Error (a)	35	33.01	220.76	11.76	1.38
Years (Y)	2	69.09*	5,074.55**	1,453.49**	365.83**
Y x S	11	29.56	361.93**	586.86**	3.36**
Y x I	8	4.40	86.78	69.51**	0.87
Y x S x I	35	4.18	15.11	2.64	0.61
Error (b)	107	20.52	133.67	9.27	0.44

Table 11. Average production from a total of seven dominant desert species from 1959-61, average percent dead material, and percent plants dead as a result of 3 years defoliation during four periods at three intensities.

Season	Intensity of harvesting	Production per plant 1959	Production per plant 1961	Percent reduction in production 1959-61	Percent crown dead 1961	Percent plants dead 1961
Winter (Jan. 1)	30	13.7	7.5	45.3	31.1	2.37
	60	21.5	10.6	50.7	36.7	5.40
	90	31.9	10.6	66.8	61.8	20.10
Average		22.3	9.5	57.4	43.2	9.30
Winter and Spring (Jan. 1 and May 1)	30	20.7	9.6	53.6	45.5	6.71
	60	29.0	8.9	69.3	66.3	20.14
	90	40.6	4.5	88.9	87.9	60.10
Average		30.1	7.6	74.8	66.6	29.00
Early Spring (April 1)	30	12.4	7.4	40.3	28.5	2.49
	60	16.7	8.5	49.1	41.8	5.76
	90	27.7	8.7	68.6	66.1	18.86
Average		18.9	8.2	56.6	45.4	9.00
Late Spring (May 1)	30	13.4	8.5	36.6	33.4	4.03
	60	20.5	10.2	50.2	48.6	12.64
	90	31.2	5.4	82.7	79.0	37.86
Average		21.7	8.0	63.1	53.6	18.18
Control	—	——	——	——	23.7	0.00
Average	30	15.1	8.2	45.7	34.8	3.90
	60	21.9	9.5	56.6	48.2	10.99
	90	28.6	7.3	74.5	73.6	34.21

Table 12. Average production, percent crown dead, and percent plants dead for seven dominant desert species as a result of three years defoliation during four periods at three intensities.

Species	Production per plant 1959	Production per plant 1961	Percent reduction in production 1959-61	Percent crown dead 1961	Percent plants dead 1961
Black sage	20.3	3.5	82.7	53.3	20.0
Big sagebrush	40.4	9.9	75.4	53.4	28.6
Shadscale	24.2	5.5	77.3	61.4	20.0
Winterfat	42.3	14.6	65.5	49.6	9.3
Nutall's saltbush	20.8	21.7	0.0	33.7	6.3
Indian ricegrass	6.4	2.2	65.6	56.7	10.2
Squirreltail grass	5.2	1.2	76.9	57.5	20.3
Control	—	—	—	23.7	0.7

Table 13. Vigor measurements on black sagebrush that had been harvested at three intensities during four seasons for a three year period (1959-61). Data taken one year after treatments ceased, August, 1962.

Season	Intensity of harvesting	Length of seed-stalk	Length current year's growth	Number seed stalks	Crown		Percent of crown dead	Percent of plants dead
					Alive	Dead		
Winter	Light	13.03	2.11	75.7	1.76	0.50	25.2	1.4
(Jan. 1)	Moderate	12.25	2.05	48.8	1.13	0.98	43.7	1.4
	Heavy	7.54	1.37	30.5	0.47	1.79	77.1	43.4
Average		10.94	1.84	51.7	1.12	1.09	48.7	15.4
Winter and Spring	Light	9.63	1.73	25.1	0.72	1.19	55.7	1.0
(Jan. 1 & May 1)	Moderate	6.59	1.01	7.7	0.19	1.53	88.9	43.4
	Heavy	0.53	0.05	0.1	0.01	1.90	99.5	93.4
Average		5.58	0.93	11.0	0.30	1.54	91.0	45.9
Early Spring	Light	12.06	2.12	46.2	1.44	0.61	33.5	1.0
(April 1)	Moderate	10.63	1.83	28.7	1.09	1.06	48.4	1.0
	Heavy	5.55	0.89	11.3	0.27	1.55	82.1	53.4
Average		9.42	1.61	28.7	0.93	1.07	54.7	18.5
Spring	Light	10.30	1.80	44.6	1.20	0.84	35.0	6.7
(May 1)	Moderate	10.45	1.75	31.8	0.82	1.28	61.5	6.7
	Heavy	1.63	0.31	2.0	0.04	2.09	97.9	76.7
Average		7.46	1.28	26.1	0.69	1.40	77.2	30.0
Controls	—	13.23	2.25	64.3	2.19	0.64	22.5	00.0
Average	Light	11.26	1.94	47.9	1.28	0.79	46.6	2.5
	Moderate	9.98	1.66	29.3	0.81	1.21	67.8	13.2
	Heavy	3.82	0.65	11.0	0.20	1.83	89.1	66.7

Table 14. Vigor measurements on big sagebrush that had been harvested at three intensities during four seasons for a three year period (1959-61). Data taken one year after treatments ceased, August, 1962.

Season	Intensity of harvesting	Length of seed-stalk	Length current year's growth	Number seed stalks	Crown		Percent of crown dead	Percent of plants dead
					Alive	Dead		
Winter (Jan. 1)	Light	9.17	3.73	98.7	2.86	1.25	31.8	2.0
	Moderate	9.07	3.22	58.5	2.10	1.39	40.5	1.7
	Heavy	2.88	1.25	15.6	0.33	2.42	86.4	60.0
Average		7.04	2.73	57.6	1.76	1.69	52.9	21.3
Winter and Spring (Jan. 1 & May 1)	Light	9.48	3.41	73.3	1.56	1.22	43.9	2.0
	Moderate	5.34	2.08	16.8	0.54	2.11	81.0	1.7
	Heavy	0.00	0.00	0.0	0.00	3.17	100.0	86.7
Average		4.94	1.83	30.0	0.70	2.17	75.0	30.2
Early Spring (April 1)	Light	10.57	3.96	105.3	2.89	0.63	19.3	1.0
	Moderate	9.91	4.19	67.4	2.15	0.89	33.9	6.7
	Heavy	4.72	1.76	14.7	0.50	2.39	81.1	40.0
Average		8.40	3.30	62.5	1.85	1.30	44.7	15.9
Late Spring (May 1)	Light	11.63	4.09	82.4	2.52	0.81	22.0	3.4
	Moderate	9.06	3.06	67.0	2.15	1.21	39.2	1.7
	Heavy	1.62	0.62	3.7	.11	2.63	95.8	66.7
Average		7.44	2.59	51.0	1.59	1.55	52.3	23.9
Control	---	13.58	4.30	119.4	3.76	0.79	16.2	00.0
Average	Light	10.21	3.80	89.9	2.46	0.98	29.2	2.1
	Moderate	8.34	3.14	52.4	1.73	1.40	48.6	2.9
	Heavy	2.31	0.91	8.5	0.23	2.65	90.8	63.4

Table 15. Vigor measurements on shadscale that had been harvested at three intensities during four seasons for a three year period (1959-61). Data taken one year after treatments ceased, August, 1962.

Season	Intensity of harvesting	Length of seed-stalk	Length current year's growth	Number seed stalks	Crown		Percent of crown dead	Percent of plants dead
					Alive	Dead		
Winter (Jan. 1)	Light	3.96	5.08	42.5	2.11	0.99	43.3	2.4
	Moderate	3.14	4.62	29.3	1.43	0.71	40.2	2.0
	Heavy	1.02	2.68	5.4	0.40	1.24	79.6	60.0
Average		2.71	4.13	25.7	1.32	0.98	54.4	21.5
Winter and Spring (Jan. 1 & May 1)	Light	3.86	3.60	28.7	1.08	1.12	53.6	30.4
	Moderate	0.73	2.05	1.6	0.34	1.45	83.3	60.0
	Heavy	0.00	0.00	00.0	0.00	1.55	100.0	100.0
Average		1.44	1.97	10.1	0.47	1.37	78.9	63.5
Early Spring (Apr. 1)	Light	4.55	4.64	39.1	1.70	0.71	31.2	1.0
	Moderate	3.27	5.05	25.0	1.50	1.15	50.2	2.0
	Heavy	0.87	2.16	3.3	0.37	1.58	81.0	66.7
Average		2.90	3.95	22.5	1.19	1.15	54.1	23.3
Late Spring (May 1)	Light	3.09	3.68	14.9	1.00	1.15	51.2	2.4
	Moderate	2.07	3.10	11.2	0.63	1.44	67.3	36.7
	Heavy	0.56	0.63	1.3	0.09	1.55	94.5	86.7
Average		1.91	2.47	9.1	0.57	1.38	71.0	41.9
Control	—	5.08	8.18	40.0	2.20	0.95	32.3	00.0
Average	Light	3.80	4.32	31.3	1.47	0.99	44.8	90.5
	Moderate	2.30	3.70	16.8	0.98	1.19	60.3	25.2
	Heavy	0.61	1.37	2.5	0.22	1.48	88.8	78.4

Table 16. Vigor measurements on winterfat that had been harvested at three intensities during four seasons for a three year period (1959-61). Data taken one year after treatments ceased, August, 1962.

Season	Intensity of harvesting	Length of seed-stalk	Length current year's growth	Number seed stalks	Percent of crown dead	Number of plants		Percent of plants dead
						Alive	Dead	
Winter (Jan. 1)	Light	10.87	5.34	6.9	28.2	17.2	4.0	16.2
	Moderate	9.31	5.03	5.3	30.2	19.8	4.7	16.8
	Heavy	9.81	4.68	7.8	44.3	15.9	8.0	33.3
Average		9.99	5.02	6.7	34.2	17.6	5.6	22.1
Winter and Spring (Jan. 1 & May 1)	Light	10.38	5.02	6.3	34.4	16.5	6.6	25.1
	Moderate	9.84	4.20	4.5	46.8	16.8	9.6	35.9
	Heavy	5.76	3.50	1.7	79.8	5.8	18.4	75.4
Average		8.66	4.24	4.2	53.7	13.0	11.5	45.5
Early Spring (April 1)	Light	8.58	5.10	7.3	26.2	17.5	5.5	20.8
	Moderate	9.01	4.86	6.0	37.9	19.5	8.3	28.3
	Heavy	9.40	5.03	4.6	45.5	14.8	7.9	31.9
Average		9.00	5.00	5.9	36.5	17.3	7.2	27.0
Late Spring (May 1)	Light	10.03	5.48	6.6	38.1	17.0	5.4	23.6
	Moderate	9.88	5.00	5.5	49.1	16.0	7.9	30.6
	Heavy	6.76	4.24	1.8	67.1	9.6	16.3	63.0
Average		8.89	4.91	4.6	51.5	14.2	9.9	39.1
Controls	—	11.15	5.90	5.8	27.7	15.8	3.4	15.9
Average	Light	9.97	5.24	6.8	31.7	17.1	5.4	21.4
	Moderate	9.51	4.77	5.3	41.0	18.0	7.6	27.9
	Heavy	7.93	4.36	4.0	59.2	11.6	12.7	50.9

Table 17. Vigor measurements on Nutall's saltbush that had been harvested at three intensities during four seasons for a three year period (1959-61). Data taken one year after treatments ceased, August, 1962.

Season	Intensity of harvesting	Length of seed-stalk	Length current year's growth	Number seed stalks	Percent of crown dead	Number of plants		Percent of plants dead
						Alive	Dead	
Winter (Jan. 1)	Light	10.25	4.61	10.8	35.2	23.7	9.4	26.6
	Moderate	10.98	4.74	12.0	40.8	21.9	7.8	24.7
	Heavy	11.17	4.45	10.3	31.7	23.3	9.4	28.8
Average		10.80	4.60	11.0	35.9	23.0	8.9	27.9
Winter and Spring (Jan. 1 & May 1)	Light	9.47	4.74	8.2	35.4	24.7	7.4	22.2
	Moderate	9.12	4.32	6.4	44.2	21.6	10.2	30.7
	Heavy	7.49	4.07	2.8	56.4	17.0	13.8	47.8
Average		8.69	4.38	5.8	45.3	21.1	10.5	33.6
Early Spring (April 1)	Light	10.48	4.60	14.2	29.5	24.2	5.7	16.1
	Moderate	11.86	4.59	12.9	36.0	24.1	7.7	21.5
	Heavy	10.29	4.85	7.2	42.5	22.5	10.0	28.9
Average		10.88	4.68	11.4	36.0	23.6	7.8	22.2
Late Spring (May 1)	Light	9.57	4.35	8.4	31.0	24.5	8.8	22.8
	Moderate	9.29	4.39	8.1	42.9	22.9	10.2	30.9
	Heavy	7.89	4.51	3.9	45.4	18.6	12.5	40.2
Average		8.92	4.42	6.8	39.8	22.0	10.5	31.3
Control	---	11.83	5.34	15.1	30.4	21.5	58.0	17.7
Average	Light	9.94	4.57	10.4	32.8	24.3	7.8	21.9
	Moderate	10.31	4.51	9.8	40.9	22.6	9.0	27.0
	Heavy	9.21	4.47	6.0	44.0	20.4	11.4	36.4

Table 18. Vigor measurement on Indian ricegrass that had been harvested at three intensities during four seasons for a three year period (1959-61). Data taken one year after treatments ceased, August, 1962.

Season	Intensity of harvesting	Length of seed-stalk	Length current year's growth	Number of seed-stalks	Basal area	Basal crown alive rating[1/]	Percent of plants dead
Winter (Jan. 1)	Light	23.35	19.29	16.0	0.49	3.9	00.0
	Moderate	19.22	15.87	16.2	0.44	3.9	6.7
	Heavy	17.15	13.08	15.7	0.52	4.2	20.0
Average		19.91	16.08	16.0	0.49	4.0	8.9
Winter & Spring (Jan. 1 & May 1)	Light	20.93	15.33	15.2	0.38	4.3	6.7
	Moderate	14.59	12.77	8.8	0.36	4.2	23.4
	Heavy	9.83	7.54	7.3	0.19	4.9	40.0
Average		15.12	11.88	10.4	0.31	4.5	23.4
Early Spring (April 1)	Light	24.45	18.63	15.5	0.40	3.8	3.4
	Moderate	19.94	15.59	16.0	0.40	4.1	6.7
	Heavy	16.86	12.64	13.4	0.41	4.4	16.7
Average		20.42	15.62	15.0	0.40	4.1	8.93
Late Spring (May 1)	Light	23.18	17.72	18.2	0.58	3.6	00.0
	Moderate	19.15	14.83	11.2	0.32	4.2	10.0
	Heavy	10.80	9.05	2.6	0.18	5.1	30.0
Average		17.71	13.87	10.7	0.36	4.3	13.4
Controls	---	23.77	19.53	19.6	0.72	0.0	00.0
Average	Light	22.98	17.75	16.2	0.46	3.9	2.5
	Moderate	18.23	14.77	13.2	0.38	4.1	5.9
	Heavy	13.66	10.58	9.8	0.32	4.6	22.9

1/ Rating of 1 = 100% above, 2 = 75-99, 3 = 50-74, 4 = 25-49, 5 = 0-24, and 6 = 0%.

Table 19. Vigor measurements on squirreltail grass that had been harvested at three intensities during four seasons for a three year period (1959-61). Data taken one year after treatments ceased, August, 1962.

Season	Intensity of harvesting	Length of seed-stalk	Length current year's growth	Number of seed-stalks	Basal area	Basal crown alive rating[1/]	Percent of plants dead
Winter (Jan. 1)	Light	8.80	6.81	12.2	5.52	3.7	20.0
	Moderate	10.80	8.66	21.4	7.72	3.4	16.7
	Heavy	9.23	7.44	14.5	6.75	3.6	30.0
Average		9.61	7.64	16.0	6.66	3.6	22.2
Winter & Spring (Jan. 1 & May 1)	Light	8.61	6.01	9.8	6.77	4.7	33.4
	Moderate	5.32	4.23	4.4	4.87	4.6	53.4
	Heavy	1.10	1.00	0.7	3.57	5.2	76.7
Average		5.01	3.75	5.0	5.07	4.8	54.5
Early Spring (April 1)	Light	11.07	7.91	14.9	7.33	4.1	16.7
	Moderate	7.50	5.61	9.7	6.04	4.6	23.4
	Heavy	5.86	5.09	8.1	6.18	4.8	40.0
Average		8.14	6.21	10.9	6.52	4.5	26.7
Late Spring (May 1)	Light	9.81	6.94	16.8	6.79	4.3	26.7
	Moderate	5.42	4.01	5.3	4.88	5.2	56.7
	Heavy	2.42	1.59	1.2	3.79	4.9	80.0
Average		5.88	4.18	7.8	5.15	4.8	54.5
Control	—	12.12	9.10	26.2	9.12	0.0	00.0
Average	Light	9.57	6.92	13.4	6.60	4.2	24.2
	Moderate	7.26	5.63	10.2	5.88	4.5	38.0
	Heavy	4.65	3.78	6.1	5.07	4.6	56.7

1/ Rating of 1 represent 100% alive; 2 = 75-99; 3 = 50-74; 4 = 25-49; 5 = 0-24; and 6 = 0% alive.

Table 20. Analysis of variance for vigor measurements presented in Tables 13 and 14 for data collected August, 1962 on second phase of study carried out during 1959-61. 1/

Source	D.F.	Mean Squares: Length seed-stalk	Length current year's growth	Number seed-stalks	Area crown alive	Area crown dead	Percent crown dead
Black sage (1)							
Total	359						
Reps.	2	950.4	12.75	55,536	8.59	2.54	9,243
Season (S)	3	488.2**	14.22**	25,396**	11.22**	4.85*	34,898**
Intensity (I)	2	1899.6**	54.89**	40,961**	35.24**	33.12**	54,188**
S x I	6	41.2	1.82	1,001	.84	.63	8,686
Exp. error	22	79.4	2.34	3,545	.98	1.08	6,895
Sampling error	324	25.6	0.97	888	.45	.65	4,709
Big sagebrush (2)							
Total	359						
Reps.	2	406.2	87.14	15,119	20.74	26.88	11,220
Season (S)	3	191.5*	33.17**	18,376**	25.07**	11.86**	15,295**
Intensity (I)	2	2049.7**	275.50**	199,430**	154.19**	91.08**	118,930**
S x I	6	45.2*	4.70	3,677	3.56	1.43	2,447**
Exp. error	22	16.9	3.30	2,644	1.51	1.08	508
Sampling error	324	18.4	3.35	2,313	1.20	1.39	639

*Significant at the .05 level of probability.
**Significant at the .01 level of probability.

Table 21. Analysis of variance for vigor measurements presented in Table 15 for data collected August, 1962 on second phase of study carried out during 1959-61. 1/

Source	D.F.	Mean Squares					
		Length seed-stalk	Length current year's growth	Number seed-stalks	Area crown alive	Area crown dead	Percent crown dead
Shadscale (3)							
Total	359						
Reps.	2	188.40	174.50	15993.1	20.10	19.44	19,180
Season (S)	3	41.95	103.50**	6470.1*	16.38**	3.29*	13,803**
Intensity (I)	2	305.20**	290.30**	24854.9**	48.18**	7.13**	59,680**
S x I	6	8.60	7.41	1592.2	1.67	1.13	1,537
Exp. error	22	18.18	12.87	1999.1	2.09	0183	1,276
S[illegible]ing error	324	10.51	7.93	1265.4	0.97	0.71	8.65

*Significant at the .05 level of probability.
**Significant at the .01 level of probability.

Table 22. Analysis of variance for vigor measurements presented in Tables 16 and 17 for data collected August, 1962 on second phase of study carried out during 1959-61. 1/

Source	D.F.	Mean Squares: Length seed-stalks	Length current year's growth	Number seed-stalks	Percent crown dead	Number plants dead	Number plants alive	Percent plants dead
Winterfat (4)								
Total	359							
Reps.	2	324.5	86.30	822.0	7,203.7	2,225.8	5,412.4	11,126.1
Season (S)	3	31.38	12.23*	120.0	9,072.4**	634.7**	466.2**	10,406.6**
Intensity (I)	2	136.5**	22.78**	233.8**	23,362.8**	1,667.1**	1,462.6**	28,770.1**
S x I	6	60.37*	3.30	71.30	1,557.6	216.4**	158.5**	3,102.8**
Exp. error	22	19.27	2.73	41.27	608.0	31.2	38.9	242.5
Sampling error	324	20.08	1.67	32.89	387.0	25.4	23.4	218.2
Nutall saltbush (5)								
Total	359							
Reps.	2	298.4	43.03	3782.5	8,704.6	4,907.9	16,552.0	23,512.0
Season (S)	3	128.8**	2.78	759.4**	1,770.5	135.3*	235.2	39,655.3
Intensity (I)	2	34.90	0.68	677.4*	3,892.4	418.9**	506.3**	31,840.5
S x I	6	16.76	1.86	60.66	9,742.8	57.9	147.6	19,237.1
Exp. error	22	14.33	3.75	137.0	4,266.8	30.5	87.2	11,831.2
Sampling error	324	17.56	5.19	61.18	4,558.8	39.9	74.4	10,856.8

*Significant at the .05 level of probability.
**Significant at the .01 level of probability.

Table 23. Analysis of variance for vigor measurements presented in Tables 18 and 19 for data collected August, 1962 on second phase of study carried out during 1959-61.

Source	D.F.	Mean Squares: Length seed-stalks	Length current year's growth	Number seed-stalks	Basal area 1/	Basal crown alive rating
Indian ricegrass (6)						
Total	359					
Reps.	2	2489.7	1224.6	7259.3	5.27	60.2
Season (S)	3	526.8	277.5	739.2	.50*	3.8
Intensity (I)	2	2604.4**	1555.2**	1254.6*	.59*	17.7**
S x I	6	86.07	20.87	385.2	.34	2.2
Exp. error	22	270.9	114.3	274.6	.16	1.5
Sampling error	324	78.31	34.28	179.4	.13	1.3
Squirreltail grass (7)						
Total	359					
Reps.	2	508.7	101.2	5304.5	350.7	44.7
Season (S)	3	396.8**	295.7**	2015.8*	66.2*	31.2**
Intensity (I)	2	727.0**	298.7**	1621.2*	69.8	5.1
S x I	6	119.5	68.2	686.1	42.8	2.7
Exp. error	22	67.95	28.22	505.8	21.8	2.0
Sampling error	324	47.76	19.82	265.5	10.9	2.3

1/Species 6 (Indian ricegrass) was Basal Area.
Species 7 (Squirreltail grass) was Basal Diameter.

*Significant at the .05 level of probability.
**Significant at the .01 level of probability.

Table 24. Inches of precipitation during 1962 at Curlew Valley.

Month	Gauge Location			Average
	Winter-fat	Nuttall's saltbush	Sitanion	
January	0.71	0.27	0.66	0.55
February	1.04	1.04	1.10	1.06
March	0.38	0.38	0.44	0.40
April	0.49	0.55	0.22	0.42
May	1.59	1.59	1.87	1.68
June	0.38	0.44	0.49	0.44
July	0.82	0.99	0.82	0.88
August	0.38	0.33	0.16	0.29
September	0.66	0.44	0.71	0.60
October	0.38	0.49	0.33	0.40
November	0.22	0.16	0.27	0.22
December	0.00	0.00	0.00	0.00
Total	7.05	6.68	7.07	6.94

Table 25. Inches of precipitation during 1962 at Kelton.

Month	Gauge Location			Average
	Nuttall's	Shadscale	Grass	
January	0.82	1.10	0.38	0.77
February	1.22	.60	1.37	1.06
March	0.27	0.55	0.44	0.42
April	0.77	0.66	0.66	0.70
May	1.87	1.54	1.65	1.69
June	0.16	0.55	0.55	0.42
July	0.38	0.05	0.27	0.23
August	0.71	0.33	0.71	0.58
September	0.55	0.99	0.99	0.84
October	0.44	0.71	0.82	0.66
November	0.27	0.16	0.05	0.16
December	0.00	0.00	0.00	0.00
Total	7.46	7.24	7.89	7.53

Table 26. Inches of precipitation during 1962 at Rush Valley.

Month	Gauge Location			Average
	Sagebrush	Winterfat	Shadscale	
January	.77	.44	.28	.50
February	.99	.83	.94	.92
March	.77	.66	.77	.73
April	1.33	1.33	1.27	1.31
May	1.10	1.05	1.10	1.08
June	.99	.83	.77	.86
July	.66	.83	.94	.81
August	.00	.00	.11	.04
September	.33	.28	.28	.30
October	.00	.00	.06	.02
November	.11	.17	.28	.19
December	.33	.11	.11	.18
Total	7.38	6.53	6.91	6.94